

REMARKS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 1, 2, 4-7, 13-15, 18, 19, and 21-23 are currently pending. Claims 9-12 and 20 have been canceled without prejudice; Claims 1, 13, 18, and 19 have been amended; and Claims 21-23 have been added by the present amendment. The changes and additions to the claims are supported by the originally filed specification and do not add new matter.

In the outstanding office action, Claim 20 was rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement; Claims 11 and 12 were rejected under 35 U.S.C. §112, second paragraph; Claims 1, 2, 5, 7, 10, 12, 13, 15, 18, and 19 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese Application No. 2001/002430 to Honma et al. (hereinafter “the ‘430 patent”) in view of U.S. Patent No. 6,044,667 to Chenoweth (hereinafter “the ‘667 patent”), Japanese Patent Application No. JP 56-31188 to Sato (hereinafter “the ‘188 patent”), U.S. Patent No. 5,364,426 to Richards (hereinafter “the ‘426 patent”), U.S. Patent No. 3,997,316 to Koontz (hereinafter “the ‘316 patent”), further in view of U.S. Patent No. 3,806,621 to Machlan (hereinafter “the ‘621 patent”); Claims 13 and 15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese Application No. 02-188489 to Watanabe et al. (hereinafter “the ‘489 patent”) in view of the ‘644, ‘188, and ‘426 patents; Claims 4, 6, 9, and 11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the ‘430, ‘667, ‘188, ‘426, ‘316, and ‘621 patents, further in view of U.S. Patent No. 6,886,364 to Ohama et al. (hereinafter “the ‘364 patent”); Claim 14 was rejected under 35 U.S.C. § 103(a) as being unpatentable over the ‘489, ‘667, ‘188, ‘429, and the ‘364 patents; Claim 20 was rejected under 35 U.S.C. §103(a) as being unpatentable over the ‘430, ‘667, ‘188, ‘426, ‘316, and ‘621 patents, further in view of U.S. Patent No. 3,422,206 to Baker et al. (hereinafter “the ‘206 patent”); and

Claim 1 was provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claims 1 and 6 of co-pending Application No. 12/564,196, in view of the '364 and '626 patents.

Applicants respectfully submit that the rejection of Claim 20 under 35 U.S.C. §112, first paragraph, is rendered moot by the present cancellation of Claim 20.

Applicants respectfully submit that the rejection of Claims 11 and 12 under 35 U.S.C. §112, second paragraph, is rendered moot by the present cancellation of Claims 11 and 12.

Amended Claim 1 is directed to a process of reforming a quartz glass crucible, wherein the quartz glass crucible is reformed by an arc discharge generated by electrodes positioned around a rotational axis and configured to heat an inside surface of the crucible while the crucible is rotated, the process comprising: (1) using an electrode structure having $3n$ electrodes with 3-phase alternating electric current, n being equal to or larger than 2, wherein neighboring electrodes are positioned at regular intervals from each other in a ring-like configuration so as to form a stable ring-like arc between the neighboring electrodes, without generating a continuous arc between electrodes facing each other across a central portion of the ring-like configuration; (2) heating the inside surface of the crucible while the crucible is rotated, wherein a diameter of the crucible is 28 inches or more, and a radius r of the ring-like configuration around the rotational axis is at least $\frac{1}{4}$ of a radius R of an open portion of the crucible, but not greater than R , for at least a fixed time during arc heating, wherein air is passed on an outer face of the crucible at a time of the arc heating to perform air cooling; and (3) removing one of a foreign substance located on the inside surface and a bubble located under the inside surface by arc discharge. The changes to Claim 1 are supported by the originally filed specification and do not add new matter.¹

¹ See page 9, lines 31-33 of the specification.

In a non-limiting example, Applicants submit that an advantage of the air cooling limitation recited in Claim 1 is that the deformation of the crucible is more certainly prevented. In this example, in combination with the electrodes structure that does not generate a continuous arc between electrodes facing each other across a central portion of the ring-like configuration, it is possible to obtain an excellently formed crucible using the air being passed on the outer face of the crucible at the time of arc heating.

Applicants respectfully submit that the rejection of Claim 1 under 35 U.S.C. § 103(a) is rendered moot by the present amendment to that claim.

Regarding the rejection of Claim 1 under 35 U.S.C. § 103(a), the Office Action asserts that the '430 and '667 patents disclose everything in Claim 1 with the exception of the electrode structure, and relies on the '188, '426, '316, and '621 patents to remedy that deficiency.

The '430 patent is directed to a quartz glass crucible for pulling up a silicon single crystal by feeding a powdery quartz raw material into a rotating mold, forming a formed body having a crucible shape, arc melting the formed body to obtain a quartz glass crucible, and further mechanically grinding the whole inner surface of the quartz glass crucible and re-melting the inner surface by arc melting or high frequency plasma flame melting.

However, as admitted in the outstanding Office Action, the '430 patent fails to disclose the arrangement of electrodes recited in Claim 1.

Further, Applicants respectfully submit that the '430 patent fails to disclose that air is passed on an outer face of the crucible at a time of the arc heating to perform air cooling, as recited in amended Claim 1. Applicants respectfully submit that the '430 patent is silent regarding air being passed on an outer face of the crucible at a time of performing arc heating, as required by Claim 1.

The '667 patent is directed to a system for melting and delivering glass to a work area such as spinners for making fiberglass including a melter, and a melter for melting glass from batch material to form a pool of molten glass including the bottom wall, inside wall, and at least one discharged port. As shown in Figure 1A, the '667 patent discloses six electrodes equally spaced in a circular pattern about the center of a cylindrical tank. Further, the '667 patent discloses that the plurality of electrodes are arranged within the molten pool so as to generate a "hot spot" of molten glass.

However, Applicants respectfully submit that the '667 patent fails to disclose that air is passed on an outer face of the crucible at a time of the arc heating to perform air cooling, as recited in amended Claim 1. Applicants respectfully submit that the '667 patent is silent regarding this limitation.

The '188 patent is directed to arc welding method for a welding unit having a comparatively short welding seem length. The '188 patent discloses plural electrodes connected via an arc stabilizing apparatus at the output end for each phase of a multiphase alternating current power source, wherein each electrode is connected to an output terminal of one phase of the alternating current power source, and is adjacent to an electrode that is connected to an output terminal of another phase of the alternating current power source.

However, Applicants respectfully submit that the '188 patent fails to disclose that air is passed on an outer face of the crucible at a time of the arc heating to perform air cooling, as recited in amended Claim 1.

The '426, '316, and '621 patents are directed to various glass melting furnaces having various arrangements of electrodes. For example, the '426 patent discloses configurations in which six or nine electrodes are arranged at a general circular pattern. Further, the '316 patent discloses that different phases can be used to accommodate a particular arrangement of electrodes, but is nonspecific in this regard. Further, the '621 patent discloses that the design

of a furnace 50 can be adapted to a two-phase power source or to other multiphase power sources having more than three phases. However, the Applicants note that the arrangement of the electrodes disclosed by the '621 patent is not circular.

However, Applicants respectfully submit that the '426, '316, and '621 patents fails to disclose that air is passed on an outer face of the crucible at a time of the arc heating to perform air cooling, as recited in amended Claim 1.

Thus, no matter how the teaching of the '430, '667, '188, '426, '316, and '621 patents are combined, the combination does not teach or suggest that air is passed on an outer face of the crucible at a time of the arc heating to perform air cooling, as recited in amended Claim 1. Accordingly, Applicants respectfully submit that the rejection of Claim 1 is rendered moot and that Claim 1 patentably defines over any proper combination of the cited references.

Independent Claims 13, 18, and 19 recite limitations analogous to the limitations recited in Claim 1, and have been amended in a manner analogous to the amendment to Claim 1. Accordingly, for the reasons stated above for the patentability of Claim 1, Applicants respectfully submit that the rejections of Claims 13, 18, and 19 are rendered moot by the present amendment to those claims.

Regarding the rejection of Claim 13 under 35 U.S.C. §103(a) as being unpatentable over the '489, '667, '188, and '426 patents, Applicants note that, as discussed above, the '667, '188, and '426 patents fail to disclose that air is passed on an outer face of the crucible at a time of the arc heating to perform air cooling, as recited in amended Claim 1. Further, Applicants note that the '489 patent is directed to a method for regenerating a quartz crucible for pulling up silicon single crystal. However, Applicants respectfully submit that the '489 patent fails to disclose that air is passed on an outer face of the crucible at a time of the arc heating to perform air cooling, as recited in amended Claim 1. Applicants respectfully submit that the '489 patent is silent regarding this limitation.

Thus, no matter how the teachings of the '489, '667, '188, and '426 patents are combined, the combination does not teach or suggest that air is passed on an outer face of the crucible at a time of the arc heating to perform air cooling, as recited in amended Claim 1. Accordingly, Applicants respectfully submit that the rejection of Claim 13 is rendered moot, and that Claim 13 patentably defines over any proper combination of the cited references.

Regarding the rejection of dependent Claims 4, 6, 9, 11, and 14 under 35 U.S.C. § 103(a), Applicants respectfully submit that the '364 patent fails to remedy the deficiencies of the '430, '667, '188, '426, '316, '621, and '489 patents, as discussed above. Accordingly, Applicants respectfully submit that the rejections of the above-noted dependent claims are rendered moot by the present amendment to Claims 1 and 13. Further, Applicants note that the rejection of Claim 11 is rendered moot by the present cancellation of Claim 11.

Applicants respectfully submit that the rejection of Claim 20 under 35 U.S.C. §103(a) is rendered moot by the present cancellation of that claim.

The present amendment also sets forth new dependent Claims 21-23 for examination on the merits. New Claim 21, which depends from Claim 1, clarifies that if the foreign substance is present in a depth of about less than 0.2 mm from the inside surface of the crucible, the foreign substance is removed without carrying out mechanical grinding, and if the foreign substance is present in a depth of about more than 0.2 mm from the inside surface, the inside surface of the crucible is smoothed by arc fusion after carrying out mechanical grinding. New Claim 21 is supported by the originally filed specification and does not add new matter.² New Claims 22 and 23 recite similar limitations, but depend from independent Claims 18 and 19, respectively. Accordingly, no new matter has been added.

In a non-limiting example, Applicants note that the advantage of the invention recited in Claim 21 is that unnecessary mechanical grinding is prevented. In this regard, Applicants

² See, e.g., page 10, lines 1-14 of the specification.

note that unnecessary grinding increases the cost and burden for reforming the crucible. In this example, the mechanical grinding is conducted only when necessary, and therefore reformed crucibles with excellent quality are obtained efficiently. However, Applicants note that if mechanical grinding is not always conducted, the foreign substance is not removed when the foreign substance is present and in a deep position. Accordingly, according to the invention recited in Claims 21-23, mechanical grinding is only performed when the foreign substance is present in a depth of about 0.2 mm from the inside surface. Further, Applicants submit that the limitation recited in Claims 21-23 is not disclosed in any of the cited references.

Thus, it is respectfully submitted that independent Claims 1, 13, 18, and 19 (and all associated dependent claims) patentably define over any proper combination of the cited references.

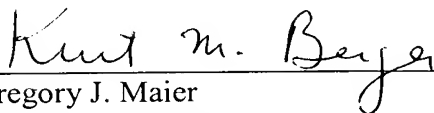
Consequently, in view of the present amendment and in light of the above discussion, the outstanding grounds for rejection are believed to have been overcome. The application as amended herewith is believed to be in condition for formal allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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